

PORT DOCUMENTATION PAGE **DTIC FILE COPY** (2)

1a. <b>AD-A197 352</b>		1b. RESTRICTIVE MARKINGS NA	
2a. NA		3. DISTRIBUTION / AVAILABILITY OF REPORT Distribution Unlimited	
2b. DECLASSIFICATION / DOWNGRADING SCHEDULE NA			
4. PERFORMING ORGANIZATION REPORT NUMBER(S) Gordon Research Conferences		5. MONITORING ORGANIZATION REPORT NUMBER(S) NA	
5a. NAME OF PERFORMING ORGANIZATION Gordon Research Conferences	6a. OFFICE SYMBOL (If applicable)	7a. NAME OF MONITORING ORGANIZATION Office of Naval Research	
5c. ADDRESS (City, State, and ZIP Code) Gordon Research Conferences Kingston, RI 02881	6b. OFFICE SYMBOL (If applicable) ONR	7b. ADDRESS (City, State, and ZIP Code) 800 N. Quincy Street Arlington, VA 22217-5000	
8a. NAME OF FUNDING / SPONSORING ORGANIZATION Office of Naval Research	8b. OFFICE SYMBOL (If applicable) ONR	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER N00014-87-G-0268	
8c. ADDRESS (City, State, and ZIP Code) 800 N. Quincy Street Arlington, VA 22217-5000		10. SOURCE OF FUNDING NUMBERS	
		PROGRAM ELEMENT NO. 61153N	PROJECT NO. RR04106
		TASK NO. 4412023	WORK UNIT ACCESSION NO.
11. TITLE (Include Security Classification) Gordon Conference on Microbial Adhesion (U)			
12. PERSONAL AUTHOR(S) R. J. Doyle			
13a. TYPE OF REPORT Final	13b. TIME COVERED FROM 06/87 TO 07/88	14. DATE OF REPORT (Year, Month, Day) 88/7/1	15. PAGE COUNT 9
16. SUPPLEMENTARY NOTATION N/A			
17. COSATI CODES		18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)	
FIELD	GROUP	SUB-GROUP	
06	03		
		Bacteria, adhesion, surface receptors, adhesins, molecular mechanisms	
19. ABSTRACT (Continue on reverse if necessary and identify by block number)			
<p>→ A Gordon Conference on the molecular mechanisms of microbial adhesion was held at Salve Regina College, Newport, RI on 25-31 July, 1987. The Conference was attended by 128 scientists from the USA, Israel, FRG, The Netherlands, Finland, Mexico, Japan, Australia, England and Sweden. The scientific programs dealt with microbial adhesion to animal, plant and artificial surfaces. The program emphasized the molecular aspects of adhesion. <i>Legionella</i> (protecting mucosa); lectins; pathogens; exopolysaccharides; <i>Pseudomonas</i> anti-bodies; <i>Escherichia coli</i>; <i>Streptococcus</i>; <i>Neisseria meningitidis</i>; <i>Staphylococcus aureus</i>; <i>Staphylococcus epidermidis</i>; <i>Staphylococcus saprophyticus</i>; <i>Staphylococcus aureus</i> (AT)</p>			
20. DISTRIBUTION / AVAILABILITY OF ABSTRACT <input checked="" type="checkbox"/> UNCLASSIFIED/UNLIMITED <input type="checkbox"/> SAME AS RPT <input type="checkbox"/> DTIC USERS		21. ABSTRACT SECURITY CLASSIFICATION U	
22a. NAME OF RESPONSIBLE INDIVIDUAL M. Marron		22b. TELEPHONE (Include Area Code) (202) 696-4760	22c. OFFICE SYMBOL ONR

**DTIC ELECTED**  
JUL 27 1988  
S H D

PRINCIPAL INVESTIGATOR: R.J. Doyle

TITLE: Gordon Conference on Mechanisms of Microbial Adhesion

## 1. Project Goals

The purpose of this conference was to organize the world's leading scientists in a conference setting. The conference speakers were to emphasize the molecular aspects of microbial adhesion.

## 2. Progress

A copy of the scientific program follows this page. Below are summaries of each section.

Session 1. In this session D. Savage reviewed work emphasizing the role of lectins in bacterial attachment to mucosa. Speakers emphasized the molecular specificity of adhesion, the role of human lectins in immunity against certain pathogens, the role of exopolysaccharides in adhesion and the role of lectin-glycolipid interactions in adhesion. Have certain organisms such as *E. coli* evolved two surface lectins to ensure adhesion (mannose specific and gal-gal binding lectins)? Why does *Pseudomonas* have a high affinity for injured and/or diseased tissue but a low affinity for normal cells? These questions were at the very cutting edge of a rapidly advancing knowledge about infectious agents.

Session 2. This session was designed to summarize (T. Wadstrom, leader) the role of fibronectin in adhesion to mucosal surfaces. In some cases fibronectin enhances adhesion to mucosa, whereas in other cases, fibronectin inhibits attachment. Is serum fibronectin the same as salivary fibronectin? How could fibronectin play a role in non-specific immunity? What are the domains of fibronectin that are responsible for binding to certain bacteria? What is the molecular basis of interaction between fibronectin and teichoic acid-containing bacteria? All of the foregoing are now being pursued in the laboratories of the speakers.

Session 3. This is relevant to infectious disease processes because it is known that enhanced phagocytosis may occur in the absence of antibodies. F. Silverblatt was the discussion leader. The session included physico-chemical aspects of adhesion coupled to phagocytosis, cooperative aspects of adhesion-phagocytosis, role of bacterial lectins in phagocytosis and specificity of non-opsonic phagocytosis. To our knowledge, this is the first time that adhesion and non-opsonic phagocytosis had been addressed from such an interdisciplinary approach.

Session 4. Eucaryotic cell adhesion was emphasized. The emerging literature has revealed that protozoa and certain fungi adhere to human tissues via lectin-like complexes. These observations are highly significant,

for they hold the prospect of reducing many common diseases found worldwide. C. Pereira has published important papers dealing with parasitic adhesion to mucosa and provided a review of eucaryotic adhesion.

Session 5. This was a timely session. T. Korhonen reviewed the genetics and molecular biology of adhesins. Are adhesins plasmid mediated? Is adhesin synthesis coupled with outer membrane synthesis, with pili, with fibrillae or other surface components? What is the significance of this? Will adhesin synthesis occur during a time of cellular starvation or cellular feasting? What are the selective pressures on the adhesin molecule? All of these questions were addressed in this session. The session integrated contemporary molecular biology with the adhesion process.

Session 6. R. Gibbons reviewed the role of microbial adhesion in the initiation of oral diseases. Special attention was paid to salivary-coated mucosal and enamel surfaces. In addition, the role of bacterium-bacterium co-aggregation processes was considered. Why does Streptococcus sanguis have such a high affinity for saliva-coated hydroxylapatite surfaces and virtually no affinity for saliva-coated mucosal surfaces? What is the role of secretory antibody in attachment of bacteria to saliva-coated surfaces? Why is S. mutans poorly adherent yet highly cariogenic? What are the characteristics of streptococcal mutants which adhere poorly? This was a very strong session with the participants composed of the original investigators of the field.

Session 7. This session, chaired by M. Fletcher, pursued the role of non-lectin surface components in adhesion. Do capsular materials contribute to adhesion. What is the molecular basis of adhesion of bacteria to rocks in streams. Do adhesion mechanisms of selected microbes in special environments play a role in pathogenesis? What governs the specificity of exopolysaccharides in adhesion to surfaces? This session emphasized the molecular aspects of bacterial cell surface interactions with the environment. Acknowledged leaders in the field were the speakers.

Session 8. This session was devoted to a highly controversial area in adhesion. It is a fact that energy minimization between two surfaces enhances interaction between those surfaces. Hydrophobic interactions seem to make this possible for many cases. A central question is how bacteria/fungi/protozoa/ or viruses can sense the environment and code for hydrophobic adhesins. Does hydrophobicity play a role in cooperative adhesion, in which the binding of one organism enhances the binding of another? What is the role of hydrophobicity in spore survival? Does the hydrophobicity of a pathogen play a role in pathogenesis? E. Rosenberg chaired this session and provided an overview.

Session 9. This was the last session of a strong program. This session was chaired by Ralph Mitchell and it encompassed biofouling of streams, bacterial interactions with root nodules, interactions between viruses and adhesion of microbes to metals and glass. This was an especially important session from the sense that one organism can displace another from a surface.



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Distribution/	
Availability Code	
Dist	Avail and/or Special
A-1	

In addition to ONR, support from the conference was obtained from

Gordon Conference Office  
US Army  
NIH  
Sockerolobat, Sweden  
Alfa-Laval, Sweden  
Eli Lilly  
Monsanto  
Barnes-Hind Labs  
Bristol-Myers  
Pfizer  
Gillette

Following the conference, many positive comments were recorded.  
Another conference is planned for summer, 1989.

## MOLECULAR MECHANISMS OF MICROBIAL ADHESION

Salve Regina College  
Newport, R.I.

July 27, 1987

### Session 1:

	<u>Time</u>
Introductory remarks, R.J. Doyle	8:20-8:30 a.m.
Lectin-glycoconjugate interactions in bacterial adhesion to mucosal tissue: D. Savage, discussion leader	8:30-9:00 a.m.
I. Ofek, Role of mannose-specific type 1 fimbriae in infection.	9:00-9:45 a.m.
C. Svanborg-Eden, P-fimbriae and attachment of <u>Escherichia coli</u> .	9:45-10:30 a.m.
Break	10:30-11:00 a.m.
R. Isaacson, Structure and function of the <u>E. coli</u> 987P pilus adhesin.	11:00-11:45 a.m.
I. Kahane, <u>Mycoplasma</u> adhesion to host cells and tissues.	11:45-12:30 p.m.

### Session 2:

Role of fibronectin in adhesion to mucosal tissue: E. Beachey, discussion leader	7:00-7:30 p.m.
J. Baseman, Adhesins of the syphilis spirochete recognize the fibronectin cell binding domain.	7:30-8:15 p.m.
A. Simpson, Role of fibronectin in the adhesion of streptococci.	8:15-9:00 p.m.

July 28, 1987

Session 3:

	<u>Time</u>
Adhesive events preceding phagocytosis and invasion into animal cells: N. Sharon, discussion leader	8:30-9:00 a.m.
F. Silverblatt, Metabolic response of PMN leukocytes to stimulation by type 1 pili.	9:00-9:45 a.m.
D. Speert, Nonopsonic recognition of <u>Pseudomonas aeruginosa</u> by human phagocytic cells.	9:45-10:30 a.m.
Break	10:30-11:00 a.m.
M. Koomey, Role of pili in the penetration of mucosal cells by <u>Neisseria gonorrhoeae</u> .	11:00-11:45 a.m.
T. Hale, Genetic, biochemical, and immunological studies of the enteroinvasive phenotype in <u>Shigella</u> spp.	11:45-12:30 p.m.

Session 4:

Adhesins of parasites and other eucaryotes: M. Pereira, discussion leader	7:00-7:30 p.m.
D. Mirelman, Amoeba-bacteria relationships in amebiasis.	7:30-8:15 p.m.
L. Douglas, Adhesion of <u>Candida albicans</u> to mucosal surfaces.	8:15-9:00 p.m.

July 29, 1987

Session 5:

	<u>Time</u>
Molecular biology of fimbrial and fibrillar adhesins: T. Korhonen, discussion leader	8:30-9:00 a.m.
B. Eisenstein, Biology of type 1 fimbriae expression in <u>Escherichia coli</u> .	9:00-9:45 a.m.
H. Seifert, Regulation of gonococcal pilin expression and the role of pilus in bacterial adhesion.	9:45-10:30 a.m.
Break	10:30-11:00 a.m.
R. Curtiss, III, Role of surface protein antigen A and dextranase in <u>Streptococcus mutans</u> colonization.	11:00-11:45 a.m.
B. Uhlin, Regulation of pilus-adhesin expression in <u>E. coli</u> .	11:45-12:30 p.m.

Session 6:

Adhesins of oral bacteria: R. Gibbons, discussion leader	7:00-7:30 p.m.
P. Fives-Taylor, Fimbriae-mediated adhesion of <u>Streptococcus sanguis</u> .	7:30-8:15 p.m.
P. Kolenbrander, Adhesins of oral <u>Bacteroides</u> and <u>Capnocytophaga</u> .	8:15-9:00 p.m.

July 30, 1987

Session 7:

	<u>Time</u>
Bacterial surface architecture and adhesion in aquatic environments: M. Fletcher, discussion leader	8:30-9:00 a.m.
S. Kjelleberg, Bacterial adhesion and altera- tions in surface components during the transient phase between growth and nongrowth.	9:00-9:45 a.m.
M. Shilo, Cell surface modulation in benthic cyanobacteria.	9:45-10:30 a.m.
Break	10:30-11:00 a.m.
K. Marshall, Reversible and irreversible adhesion to inert surfaces--are these meaningless concepts?	11:00-11:45 a.m.
R. Irvin, Contribution of pili and capsule to the adhesion of <u>Pseudomonas aeruginosa</u> to submerged steel surfaces.	11:45-12:30 p.m.
Business meeting	12:30-12:40 p.m.

Session 8:

Adhesion and the hydrophobic effect: E. Rosenberg, discussion leader	7:00-7:30 p.m.
T. Wadstrom, Role of hydrophobicity of pathogens colonizing open wounds and other tissue trauma.	7:30-8:15 p.m.
M. Rosenberg, Hydrophobins and hydrophilins of Gram-negative bacteria.	8:15-9:00 p.m.



July 31, 1987

Session 9:

	<u>Time</u>
Molecular aspects of bacterial adhesion to plants, soils, clays and metals: R. Mitchell, discussion leader	8:30-9:00 a.m.
F. Dazzo, Attachment of <u>Rhizobium trifolii</u> to white clover root hairs.	9:00-9:45 a.m.
E. Bayer, The cellulosome of <u>Clostridium thermocellum</u> .	9:45-10:30 a.m.
Break	10:30-11:00 a.m.
G. Stotzky, Microbial adhesion to clay minerals.	11:00-11:45 a.m.
A. Matthysse, Attachment of <u>Agrobacterium</u> to plant host cells.	11:45-12:30 p.m.